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Preliminary Summary and Analysis
of
Suspended Sediment Data
from
Placer Mining Operations - 1973

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INTRODUCTION

During the summer of 1973, 28 suspended sediment sampling stations were maintained (see Figure I). The objective was to collect data that would represent operations on the placer mining creeks and to analyze the data for natural stream load, amount of sediment introduced by different methods of mining, an assessment of some sediment control practices and the ability of the streams to settle out the load.

Table I	A Summary of the Suspended Sediment Data.
Table II	List of Chemical Analyses at Various Monitoring Stations presented as data only and will not be discussed in this report.
Figures 2,3 & 4	List of actual suspended sediment and discharge values chosen to represent three periods during the operating season, start-up, mid-season and the closing down of operations.
Figure 5	Location and method of operation of active placer miners on the creeks.

DISCUSSION

Firstly, there is an apparent anomaly occurring near the mouth of Hunker Creek. There are no operations between H-2 (below Hunker Placers) and H-1 (near mouth at road crossing) and, yet, there is an increase in suspended sediment load from a mean daily of 61.4 tons/day at H-2 to 189 tons/day at H-1, an increase of 128 tons/day. The area between the two was investigated and it was found that it flows through a former pond which had been contained by dredge tailings, where sediment had settled out from previous works to a depth of at least 10 feet.

Hunker Placer constructed a drain to a depth of approximately 10 feet with steep side slopes, using a dragline. The banks are very unstable and the creek is actively cutting and carrying away the sediment material. Therefore, only 30% of the suspended sediment at the mouth of Hunker Creek can be attributed to existing operations. Keeping this in mind, a comparison is made of the suspended sediment loading in Bonanza and Hunker Creeks to the Klondike River, neglecting the load from H-1 to H-2.

Bonanza and Hunker Creeks make up 5.6% of the Klondike River drainage area. The estimated natural suspended sediment load of Hunker and Bonanza Creeks contributes 1.7% and the active

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placer mining operations contribute 8.4% to the total uuspended sediment load of the Klondike River. In terms of concentration, the mean of suspended sediment concentration for the Klondike River at the mouth (K-1) during the operating season was 43 mg/l. Without placer mining it was estimated to be 39.4 mg/l. These estimates are verified by the upper Klondike station (K-2) above Hunker and Bonanza creeks which had a mean suspended sediment concentration of 38.6 mg/l.

ABSTRACT

This is a preliminary report on the suspended sediment sampling of placer mining creeks in the Klondike Gold Fields, Dawson City, Y.T.

The objective is to summarize the data by listing typical values and by discussing results from different mining techniques.

A discussion is made of the suspended sediment control practices. Results from existing operations are presented and the difficulties which may be encountered are described.

Finally, procedures for control measures are recommended.

A. THE AMOUNT OF SUSPENDED SEDIMENT FROM VARIOUS MINING TECHNIQUES

1. Ground Sluicing:

Monitoring stations H-2 and H-3 were used to isolate the ground sluicing work by Hunker Placer which was in operation from the end of May till mid-August. The suspended sediment increased from 4.6 tons/day at H-3 to 48.7 tons/day at H-2, an addition of 44.1 tons/day.

2. Hydraulicing:

Monitoring station S-4 measures the suspended sediment load from the Roy Gibson operation which is a gravity feed system for stripping by hydraulicing under a low pressure head. This particular method added 33 tons/day of suspended sediment to Friday Gulch, with a maximum concentration of 17,674 mg/l.

3. Sluicing:

Monitoring stations B-2, B-3 and B-4 were established around the King Solomon Mine operation at Grand Forks on Bonanza Creek. The method involves sluicing only, with a Cat pushing all the embankment material into the sluice box for washing. This operation added 42.7 tons/day to Bonanza Creek.

4. Recirculating:

Monitoring stations H-3, H-4 and H-5 were established around Miben Mining. This operation included a reservoir, two lift pumps and 1800 feet of 18" welded pipe at a pumping rate of 4000 gallons per min. Work is on a terrace 300 feet above

Hunker Creek and involves hydraulicing and sluicing with tailings re-entering the creek approximately 1000 feet upstream of the dam. The mine was pumping from 12 July to mid-September. The tailings area worked very well up until the end of August with the addition of only 0.5 tons/day of suspended sediment to Hunker Creek. The tailings area then began to overflow and couldn't contain the fines. On 5 September the operation was contributing 21.6 tons/day to Hunker Creek. The Company has since made a diversion of the Creek to increase the storage area of the tailings for next season.

B. SUSPENDED SEDIMENT CONTROL PRACTICES

1. Seepage Through Old Tailings:

There is an excellent example of the filtering capabilities of the old dredge tailings and ponds at Roy Gibson's operation on Sulphur Creek. He is working on the left side of the Valley using water from Friday Gulch for stripping and sluicing. The small stream which had a maximum discharge of 3 cfs carried 33 tons/day of sediment from the Gibson property. The stream stayed on the left side of the Valley for approximately 2 miles, seeping through old dredge tailings, then, finally, made its way into Sulphur Creek. The additional loading in Sulphur Creek was 1.45 tons/day, a reduction of 96%.

2. Settling Reservoirs:

The pond on the Miben Mining property, although only a depth of two to three feet, did operate as a settling reservoir till the start-up of operations on 12 July. In comparing stations H-3 at 1.5 tons/day and H-5 at 5.6 tons/day, there is a reduction of 73% of the load, or, in terms of concentration, from 160 mg/l to 30 mg/l. A grain size analysis will not be completed till mid-December. Therefore, no attempt has been made at this time to determine the required retention time.

3. Settling Out Along the Creek Channel:

The results from Bonanza Creek indicate that there is a significant amount of natural settling along its course. Between stations B-1 and B-2 there were two operations, one on a bench claim, with sluicing for only a short period, and the other, hydraulicing and sluicing in the creek valley, with tailings being discharged directly into the creek. However, the amount of suspended sediment decreased from 67 tons/day at B-2 to 19.4 tons/day at B-1. Assuming that the hydraulicing and sluicing operation between the two stations adds 33 tons/day (see Roy Gibson's operation), then the creek for a distance of approximately 12 miles, reduces the suspended sediment load by 80%.

The three examples given above are evidence that the amount of suspended sediment from a placer mining operation can be effectively reduced to acceptable levels before returning the water to the creek. Therefore, where a Water Board decision requires as a condition to a licence, that the sediment load from an operation be reduced, this can be achieved without forcing the shutdown of the operation. However, this statement must be qualified by adding "where it is physically possible to provide a settling or filtration area". An operation which does not have property downstream of the area being worked will be restricted since claims are only 500 feet wide. Also, operations in narrow gorges will not have any room for settling facilities.

C. RECOMMENDED PROCEDURES

Again, where the Water Board decides that operating conditions are necessary to control sediment the following procedures could be followed:

1. Identify the stream being affected.
2. Identify the operations causing the affect.
3. Advise the operators of a compliance schedule
    a) All facilities presently available for settling or filtration shall be utilized for the season of 1974.

    b) All new operations in 1975 require facilities.

    c) All operations in 1976 require facilities.

The adequacy of these facilities can be assessed by Analyzing water samples for suspended sediment.

What affect will these conditions have on the placer mining industry? The two most obvious answers are that operating costs will increase and that it will force the abandonment of properties that cannot provide sediment control facilities. It will also have other affects that aren't so obvious.

Presently, the only concerns of the miners when planning an operation are; Where is the water? How much water is available? What facilities are required to get the water to the work at the necessary flow rate? What stripping method should be employed? Is there an adequate drain from the workings? and, Where are the tailings going to be piled?

When working in an area requiring sediment control, they would have to become concerned about the actual use of water and may choose stripping by Cat rather than hydraulicing or ground sluicing, and about what method to use and where to put their sedimentation facilities.

TABLE I

Summary of Suspended Sediment Stations

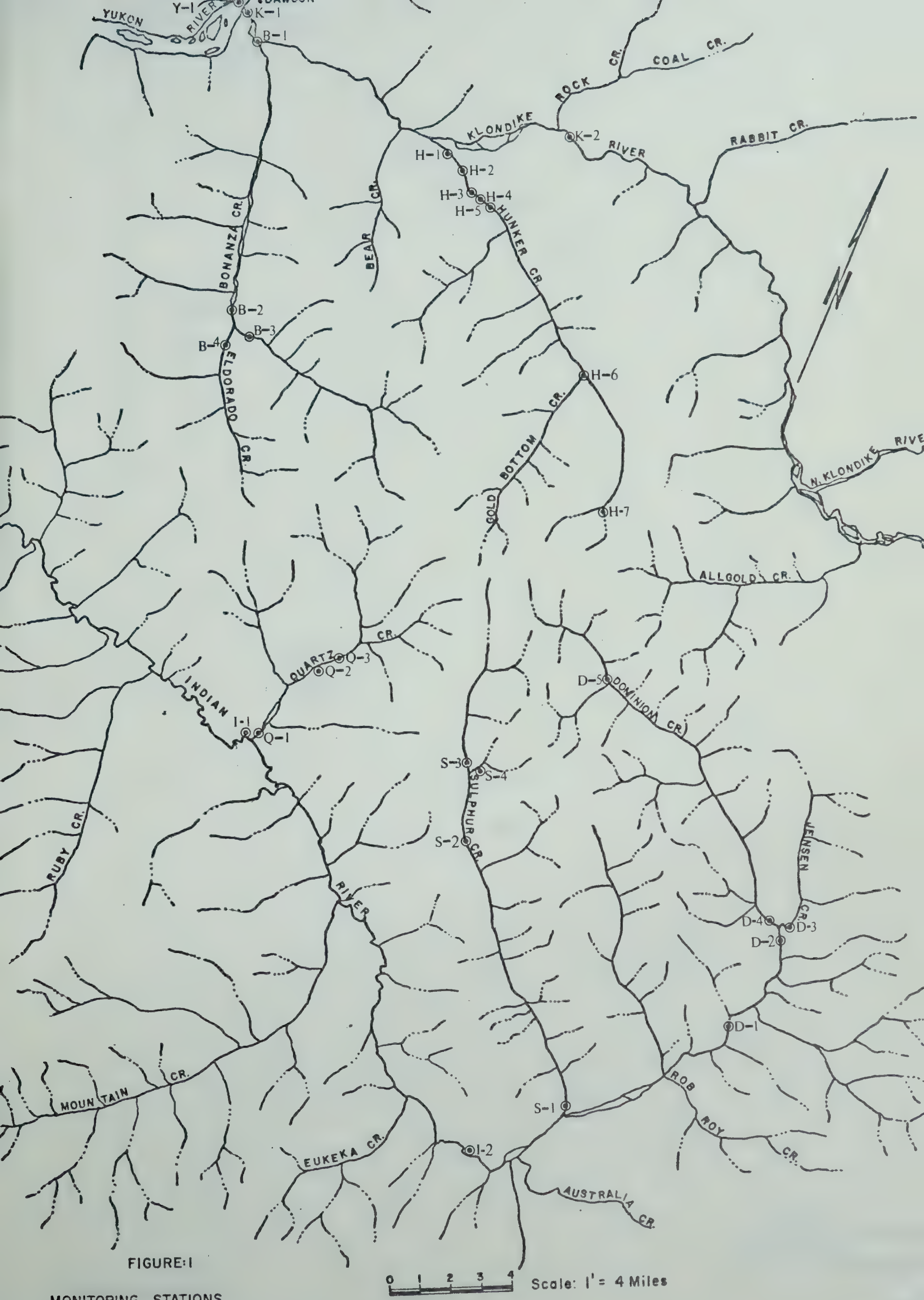
Creek	Station No.	Drainage Area Sq. Mi.	Remarks	Suspended Sediment (mg/l)		Recorded Discharge (cfs)		Mean Daily Suspended Sediment	
				Max	Min	Max	Min	tons/day	tons/day/sq.mi
Hunker	H-1	80	near mouth at road crossing	8,274	59	125	11	189	2.36
	H-2	78	below Hunker Placer (ground sluicing)	3,725	44			61.4	0.79
	H-3	75	below Miben reservoir	612	6	100^e	9	6.8	0.09
	H-4	75	at Miben reservoir	1,875	15				
	H-5	68	above Miben reservoir	1,575	19	90^e	9.5	7.8	0.11
	H-6	36.8	below confluence with Gold Bottom	28,827	107	41.2	6	87.7	2.38
	H-7	2.7	left fork of Hunker unworked	78	1.8	9	1	0.26	0.09

Bonanza	B-1	96.2	near mouth	1,223	24	108	7.9	19.4	0.20
	B-2	56.5	at Discovery claim below King Solomon Mine	4,065	123	60	9	67	1.19
	B-3		above King Solomon Mine	222	1.4	36	2.4	0.58	
	B-4	23	Eldorado Cr. above confluence with Bonanza	3,385	72	24	3.7	23.7	1.03
Sulphur	S-1	52.2	near mouth	21	0.6	60	3.8	0.66	0.01
	S-2	19.6	below Friday Gulch	74	4	68	2.3	1.65	0.08
	S-3	11.75	above Friday Gulch	12	3	6.2	1.5	0.10	0.01
	S-4	4	Friday Gulch below Roy Gibson	17,674	37	3	<0.5	33	8.2
Dominion	D-1	120.4	at Bridge site	409	60	225	29	46	0.38
	D-2		below confluence with Jensen Cr. and Black Cr.Mines	741	34	25[e]	-		
	D-3		Jensen Creek	4.4	4.4	4.0	-		
	D-4	56.3	above confluence with Jensen Creek	134	-	21.2			
	D-5	10.24	above confluence with Caribou Creek	12	1	15.7	1.5	0.08	0.01

Quartz	Q-1	58.9	near mouth	198	1.7		3		
	Q-2		below Ballart Mines	9,415	167				
	Q-3	34.2	above Ballart Mines	168	3				
Indian River	I-1		below confluence with Quartz Cr.	172	28				
	I-2		above confluence with Eureka Cr.	54	3.4				
Klondike River	K-1	3,110	below confluence with Bonanza Cr.	186	5.2	13,100	3,430	1,085	0.35
	K-2		above confluence with Hunker Cr.	139	4.6				
Yukon River	Y-1	106,000	below confluence with Klondike R.	763	58	216,000	120,000	164,000	1.55

CHEMICAL ANALYSIS AT VARIOUS MONITORING STATIONS

Fe (Ext.)	Pb (Ext.)	Mn (Ext.)	Residue Nonfilt. (105°)	Residue Fixed Nonfilt. (550°)	Sp. Cond.	Alk. ph.	Alk. Total	Hardness	SO_4	Zn	As	CN
1.5	<0.001	0.13	5996.0	5662.0	513.	0.0	145.	255.	116.	<0.001	<0.005	
0.43	<0.001	0.05			270.	0.0	47.5	131.	79.5	0.002	<0.005	
4.6	0.006	0.56	560.0	486.0	650.	0.0	172.	349.	175.	0.021	<0.005	
0.16	<0.001	0.02			167.	0.0	58.0	82.9	24.4	<0.001	<0.005	
6.2	0.009	0.36	660.0	650.0	194.	0.0	67.0	97.3	27.9	0.04	<0.005	
6.5	0.005	0.44	978.0	936.0	242.	0.0	75.0	128.	46.4	0.04	0.006	
2.7	0.003	0.22	272.0	264.0	320.	0.0	92.0	165.	78.2	0.009	<0.003	
1.3	<0.001	0.12	55.0	31.0	418.	0.0	116.	210.	97.8	0.002	<0.005	
26.	0.009	1.4			244.	0.0	92.0	122.	30.0	0.15	<0.005	



Scale: 1' = 4 Miles

FIGURE: I

MONITORING STATIONS

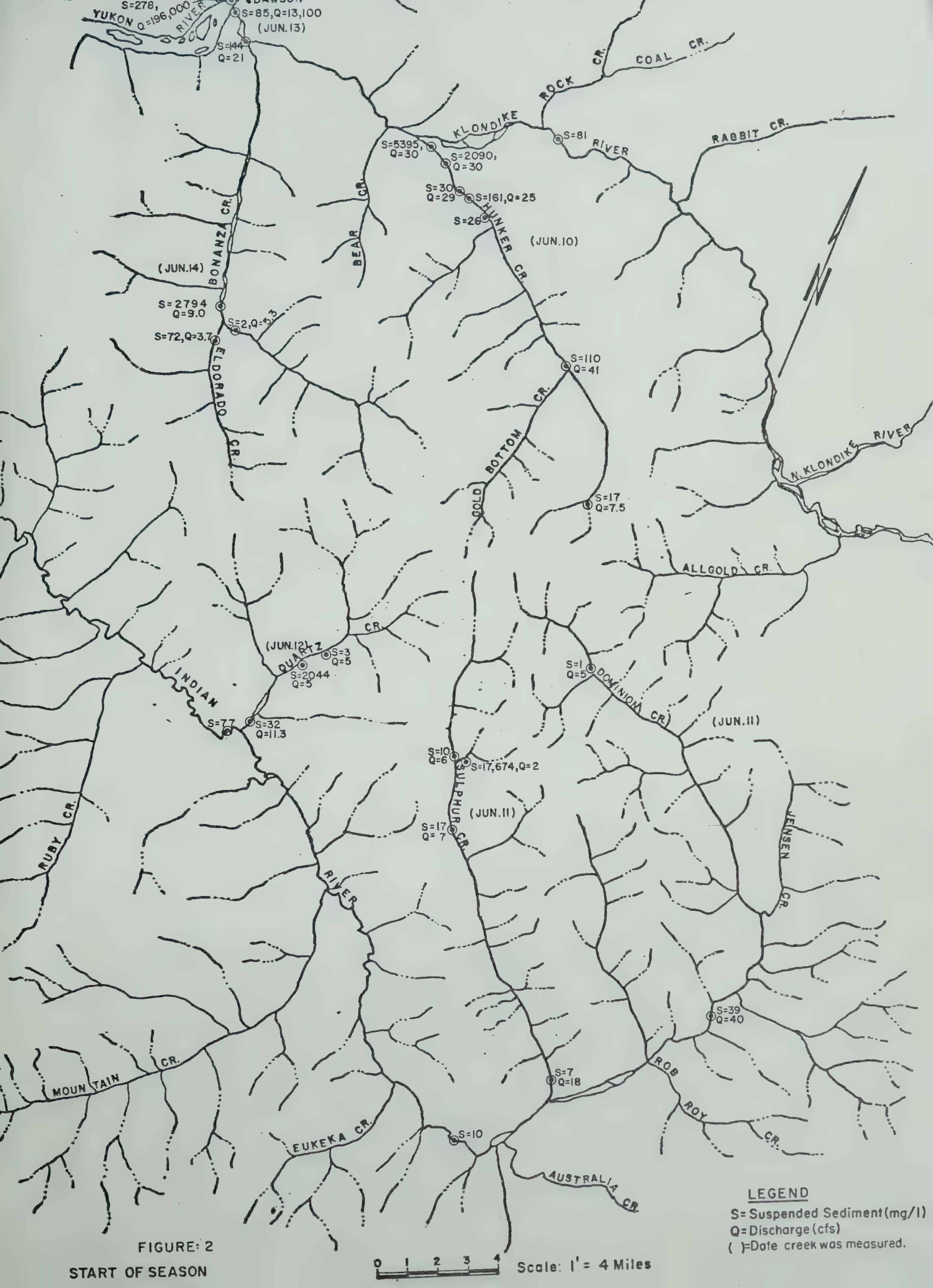


FIGURE: 2

START OF SEASON

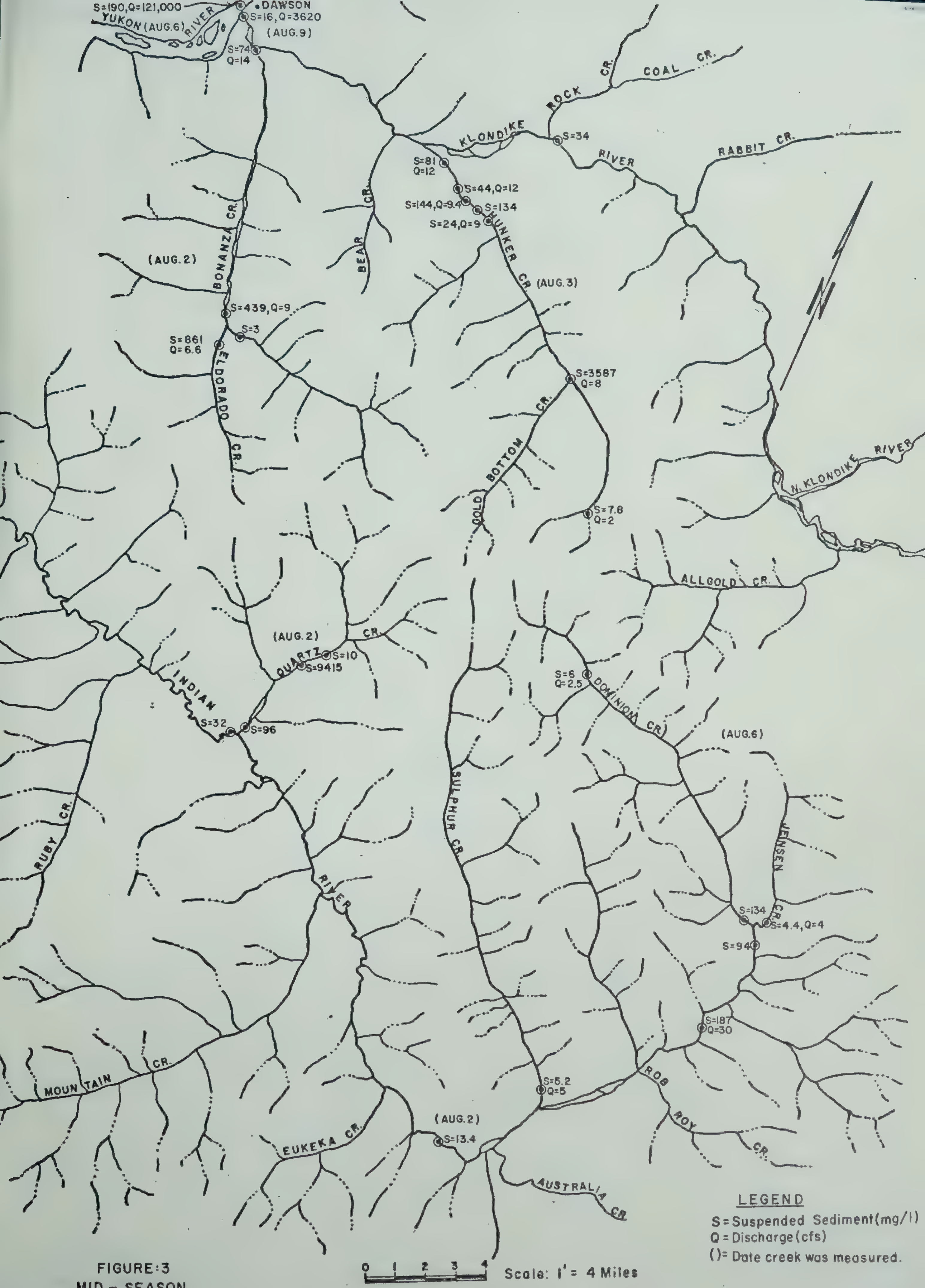


FIGURE:3
MID - SEASON

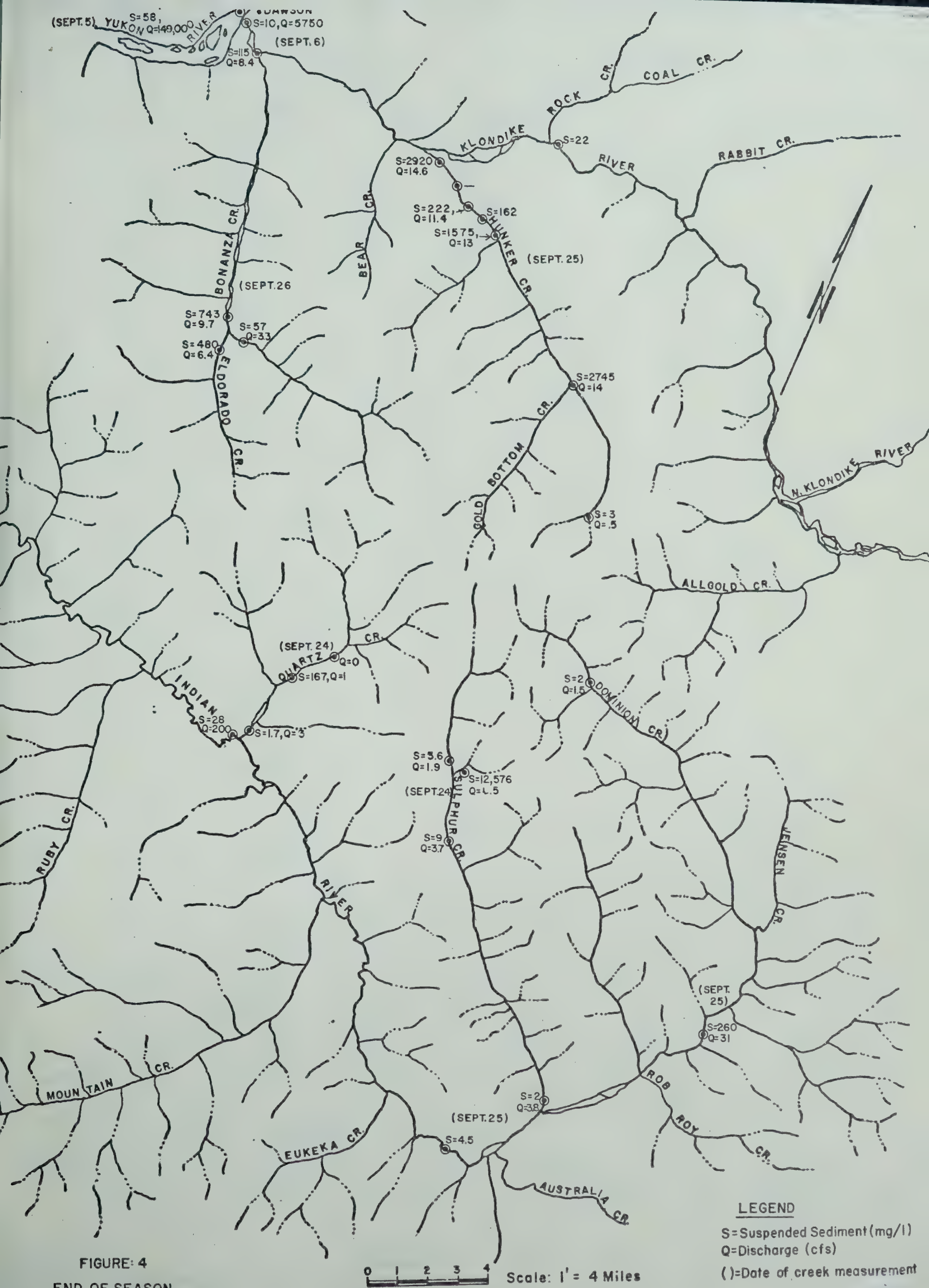
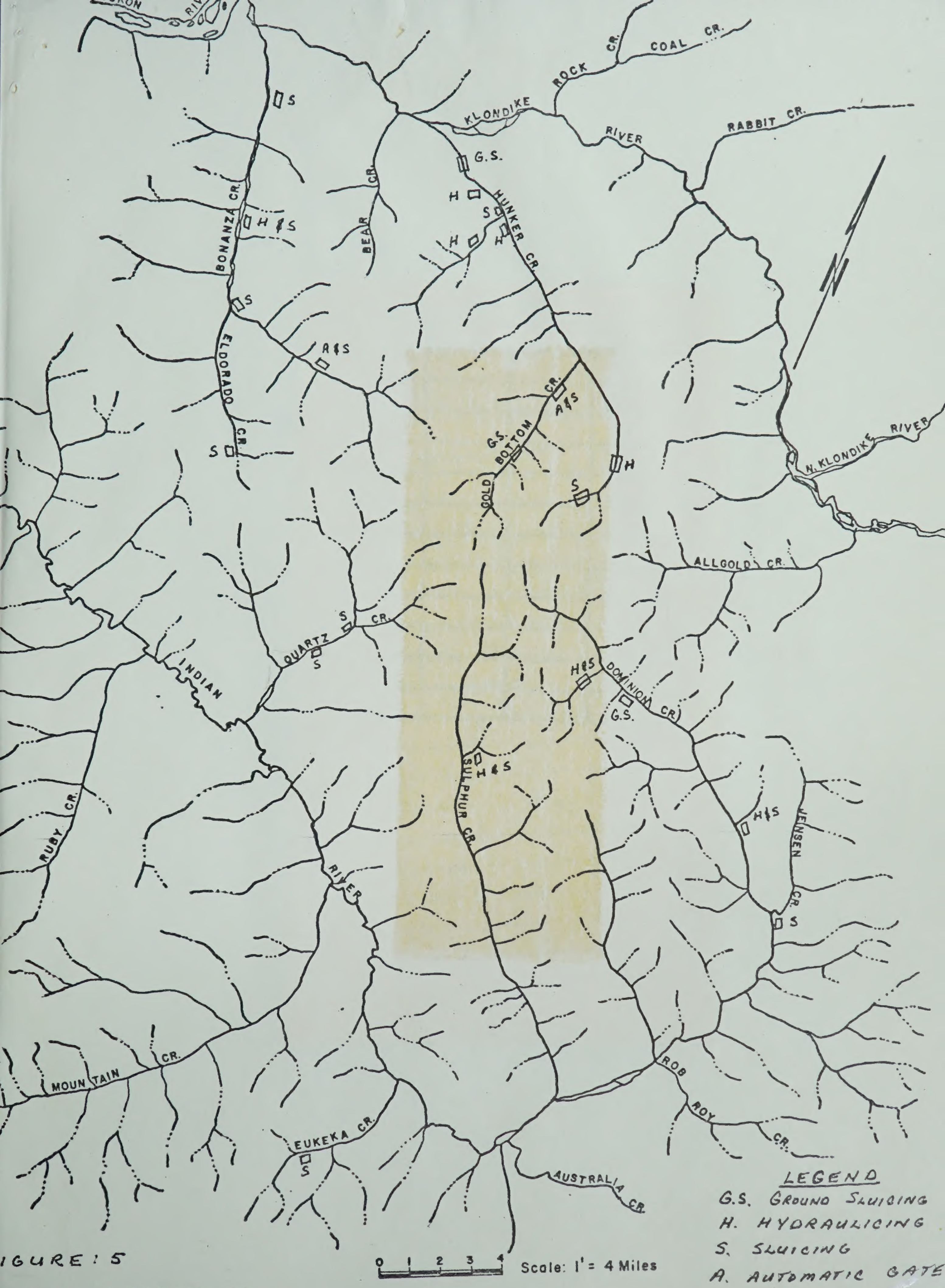


FIGURE: 4

END OF SEASON



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